

# Future of DR

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# Presentation Overview

- Trends
  - Policy
  - Technology
  - Implementations
- Load As Resource in Ancillary Services Markets
- Future directions towards responsive buildings



# Trends

## Policy

Dynamic Rates

- Large C&I, residential, small commercial

Codes and Standards

- Title 24, US Green Building Council's LEED Credits

Smart Grid Standards effort

Ancillary Services

## Technology

**Integration of Renewables**

Energy Storage Technologies – Can DR replace storage?

PHEVs and EVs

## Implementation

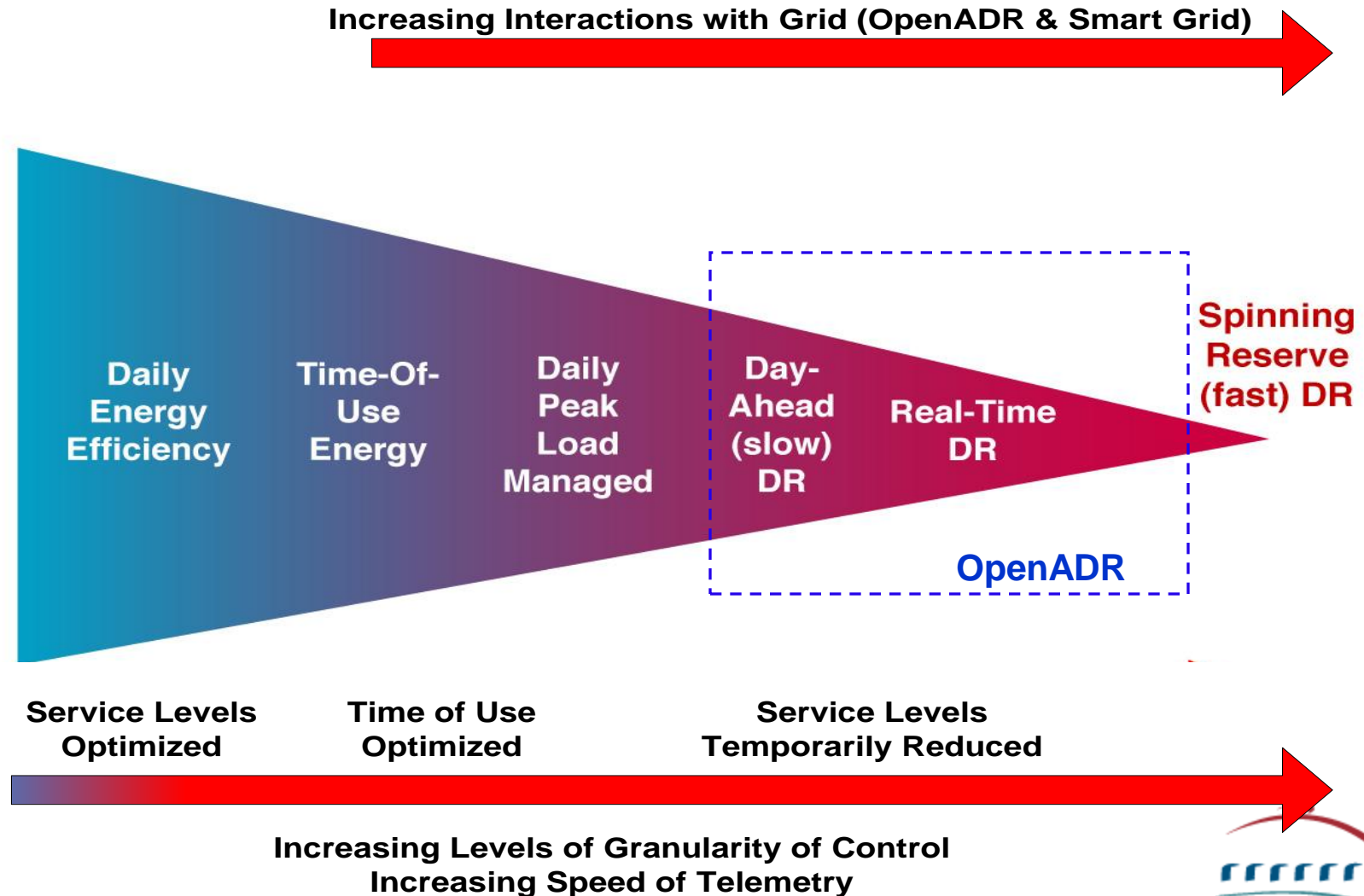
Linking Energy Efficiency and DR

Utility Implementations

Smart Grid Investment and Demonstration Grants



# Demand Side Management and Automated DR Future






# DR for Integrating Renewable Resources (IRR)

- California's Renewable Portfolio Standards: 33% renewable integration by 2020
- Wind and Solar resources are variable and intermittent
- Challenges:
  - Intra-hour variability
  - Ramping
  - Forecast error
  - Over generation

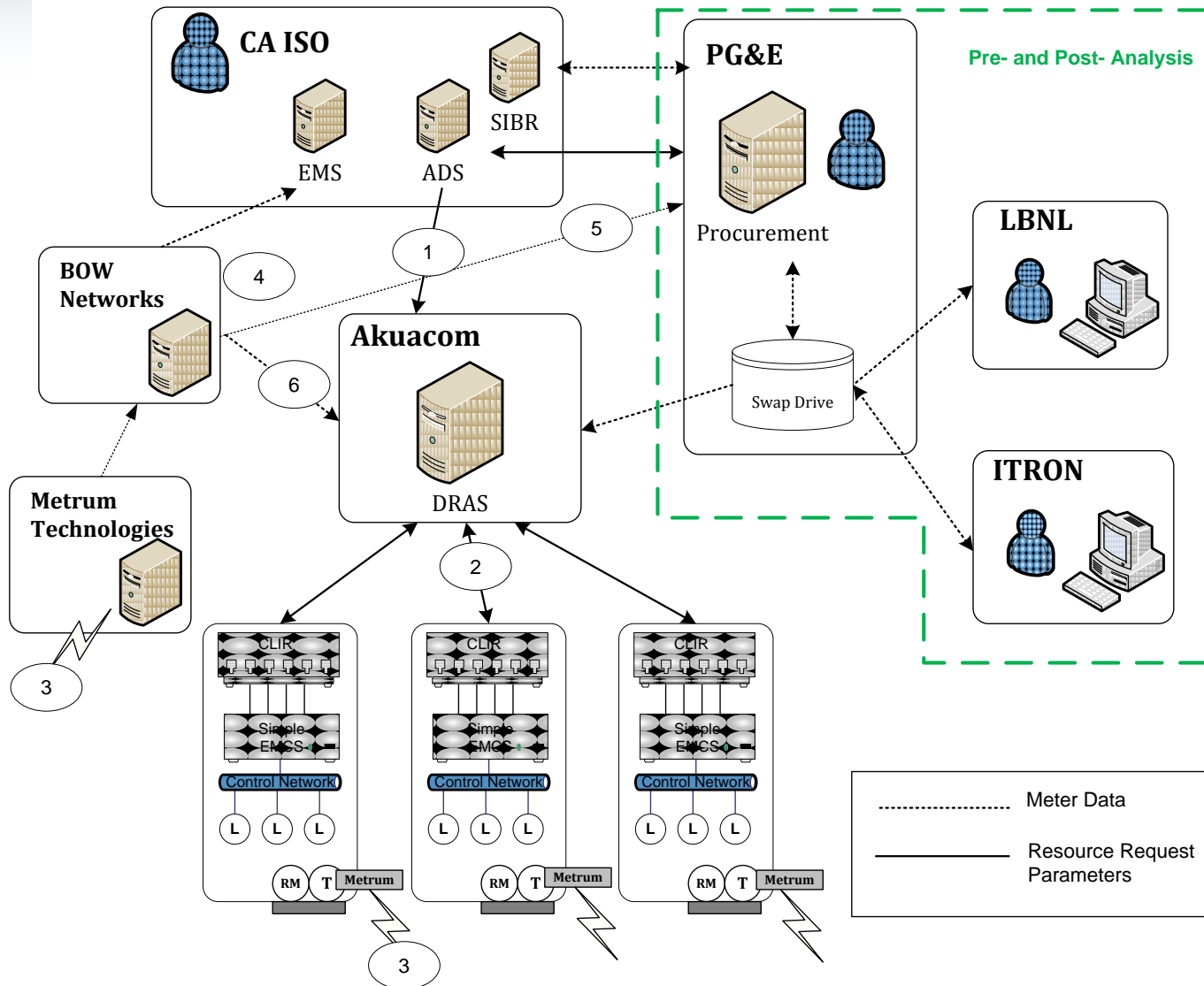
Goal: Identify communications needs and develop strategies in C&I facilities and test these to address the renewable integration challenges.



# CAISO Ancillary Services Market

AutoDR for Existing CAISO A/S products	Service	Response Time	Duration
	Regulation Up	Start <1 min.    Reach bid <10 min.	15 - 60 min.
	Regulation Down	Start <1 min.    Reach bid <10 min.	15 - 60 min.
	Non- Spinning Reserve	< 10 minutes	30 min.
Future (?)	Spinning Reserves	~ Instant Start    Full Output <10 min.	30 min.

# Participating Load Pilot (PLP)



## Acronyms:

**EMS** – Energy Management System

**ADS** – Automatic Dispatch System

**SIBR** – Scheduling Infrastructure Business Rules

**DRAS** – DR Automation Server

**CLIR** – Client Logic with Integrated Relay

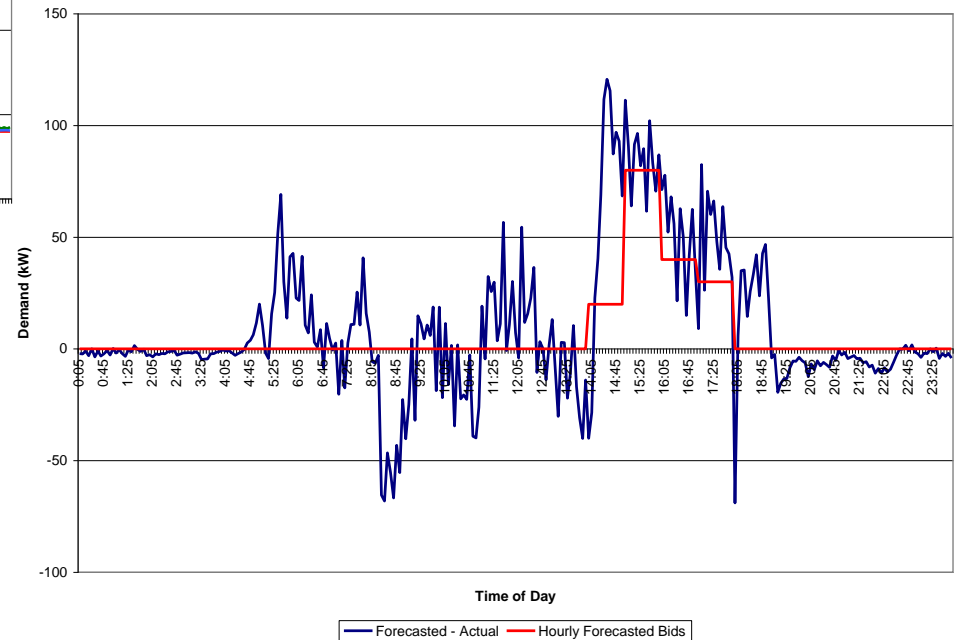
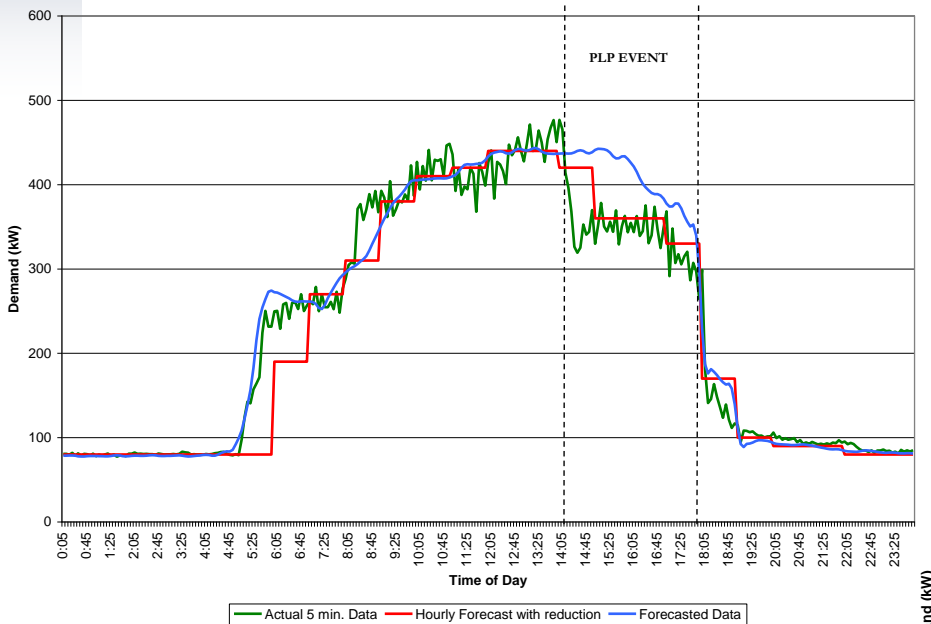
## DR Strategies at Participating Load Pilot Sites

Site	DR Strategy	DR Period
<b>IKEA EPA</b>	Turning off 11 RTUs out of 43 and raising zone setpoints to 76 DegF	Noon to 6 pm
<b>Contra Costa County</b>	4 DegF Global Temperature Adjustment with 1 DegF increments	2 pm to 6 pm
<b>Svenhards</b>	Turn off Pan Washer	3 pm to 5 pm





# Contra Costa County Building - Load regarded as Pseudo Generation



**Pseudo Generation = Forecasted – Actual Demand**



# What we learned from the Participating Load Pilot

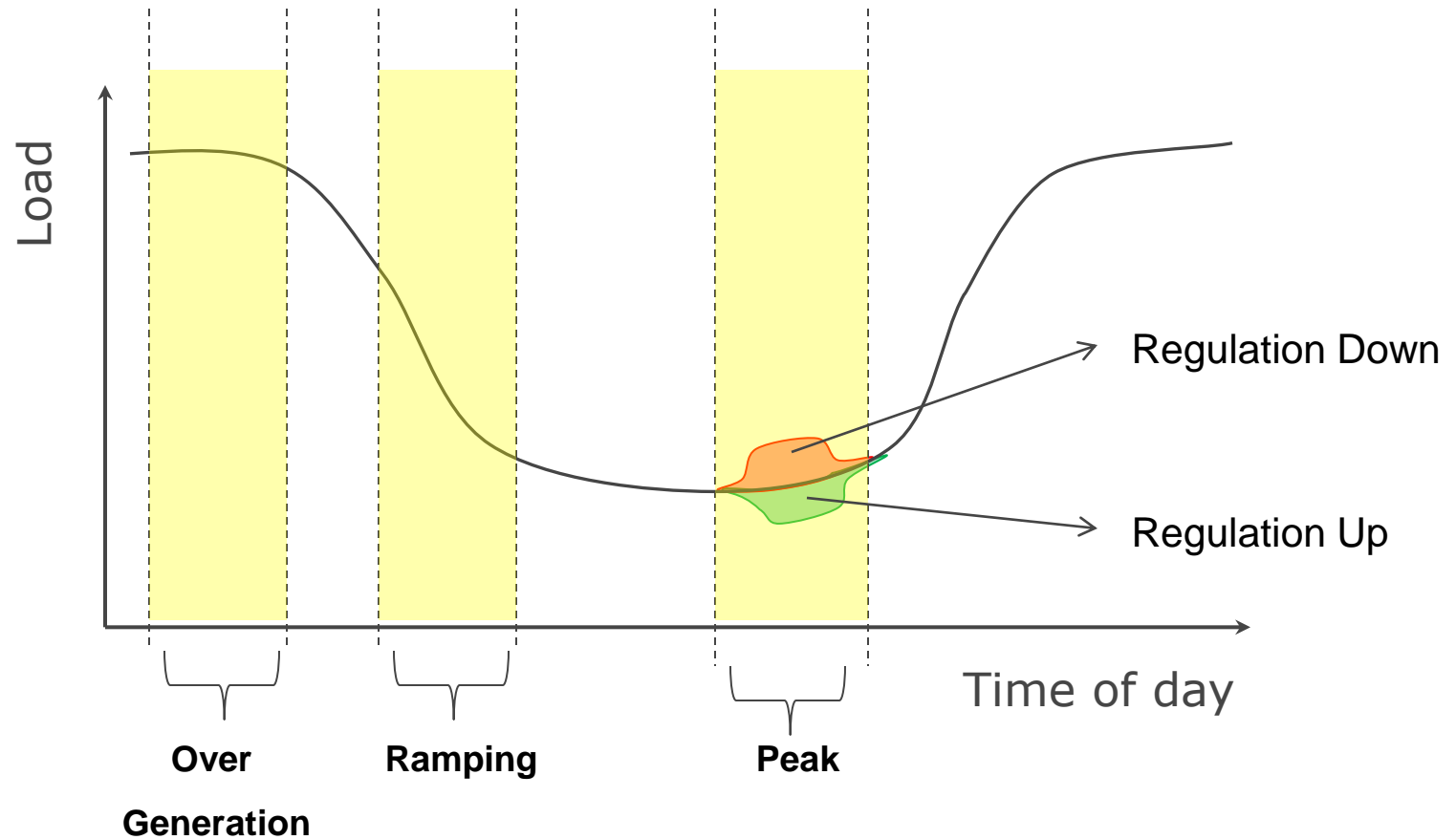
- HVAC as an end use and global temperature adjustment as a DR strategy meet the requirements for wholesale ancillary services.
- OpenADR specification is used to communicate wholesale DR events in an open and interoperable way.
  - Customer's transition from Auto-DR programs to PLP is seamless
- Internet can be used for fast DR to dispatch non-spinning ancillary services.
- **Pseudo Generation** is how DR resources are represented as generation.



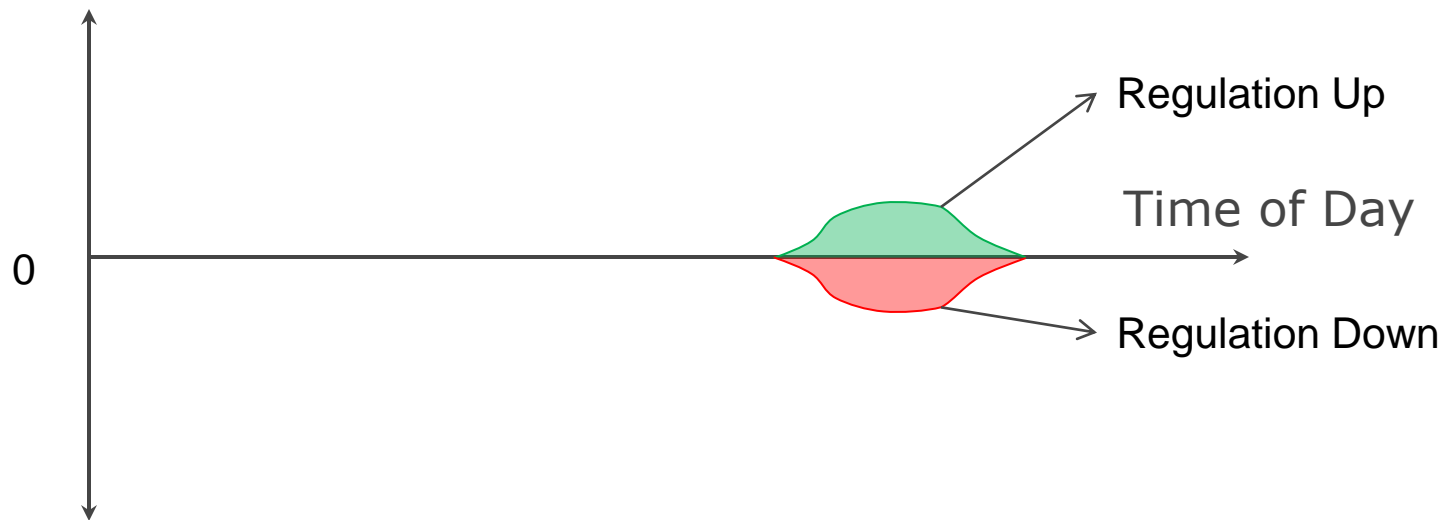
# Challenges with using load for Regulation Up and Regulation Down Products

- **Communication challenges:**
  - Four second telemetry
  - Poll vs. Push
  - Close-loop vs. Open-Loop
- **Demand Side issues:**
  - *Which end-use, How long, how often, how much?*
  - *How to represent DR as pseudo generator*
- **Integration issues**
  - *How can CAISO instruct a DR resource?*

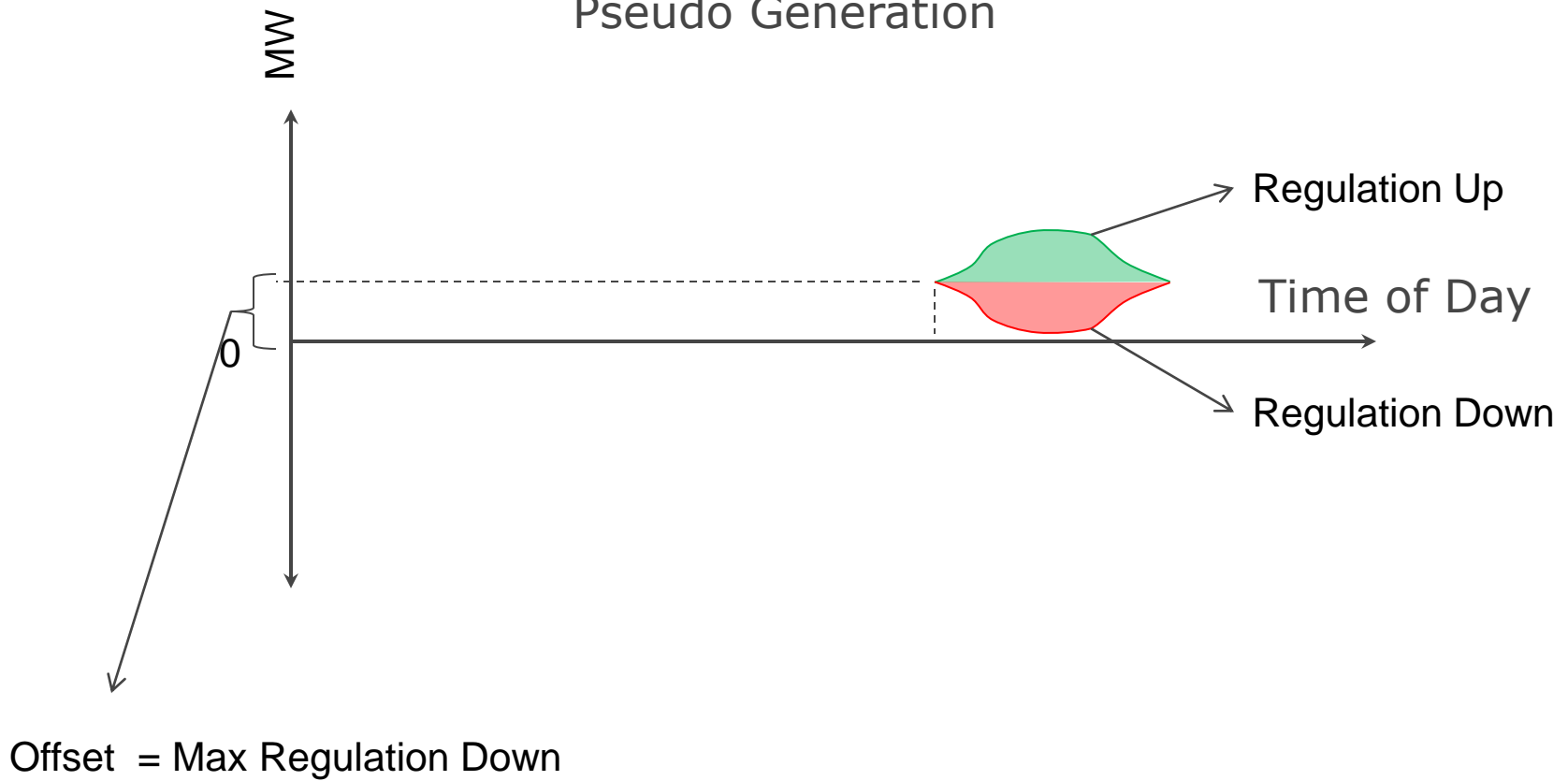


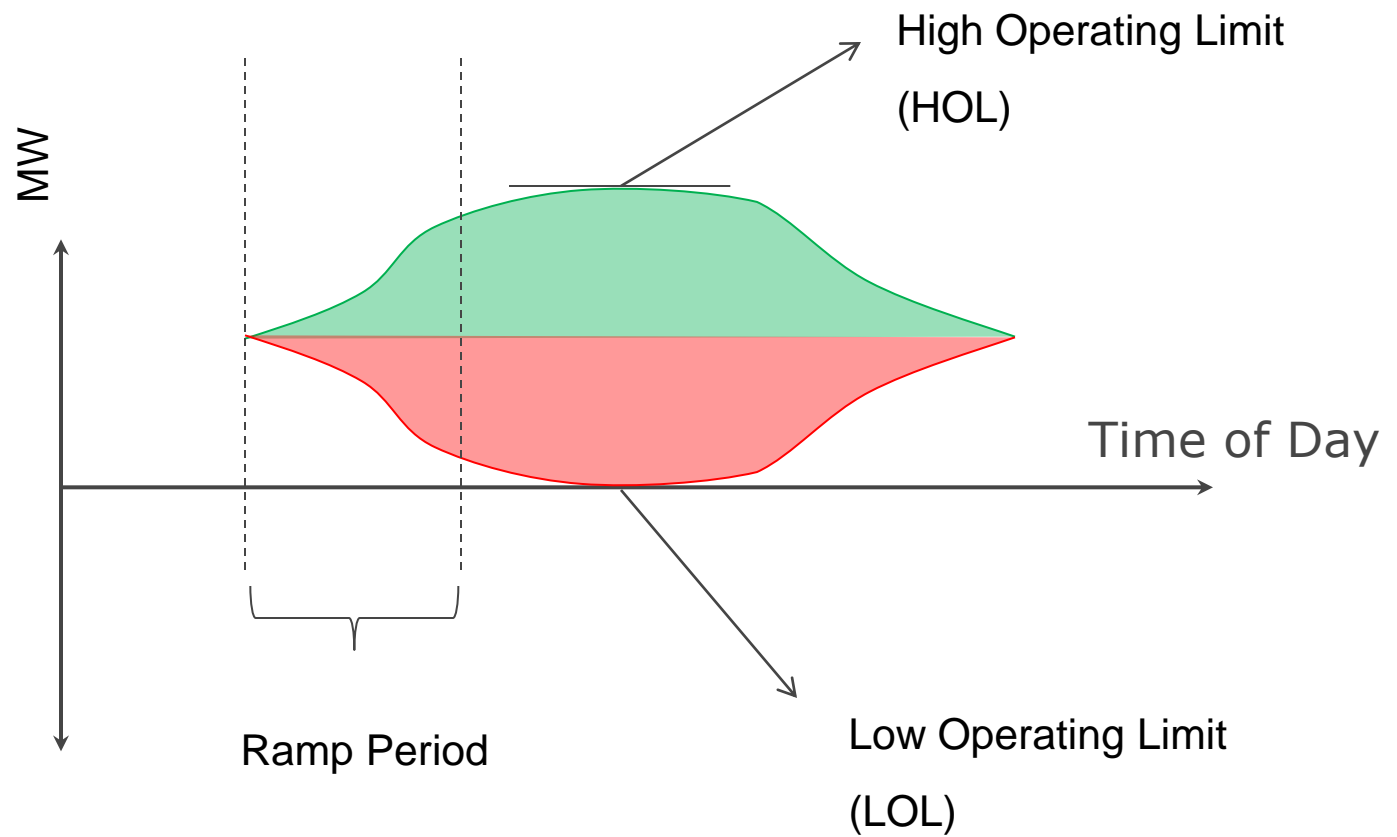


# Pseudo Generation For Regulation Up and Regulation Down

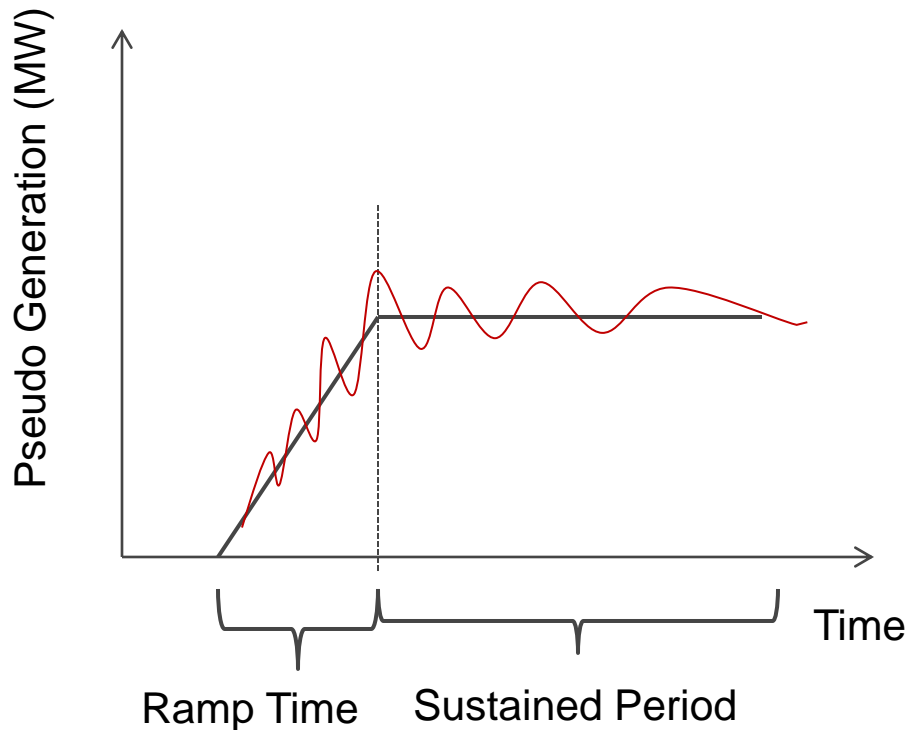


## Pseudo Generation





# Why 4 Second Telemetry



For each resource, CAISO requests the following:

- Ramp Rate (MW/s)
- High operating Limit
- Low Operating Limit

When CAISO instructs a set point to a resource, 4 sec. telemetry is used to make sure the resources is following its projected ramp rate and operating limits

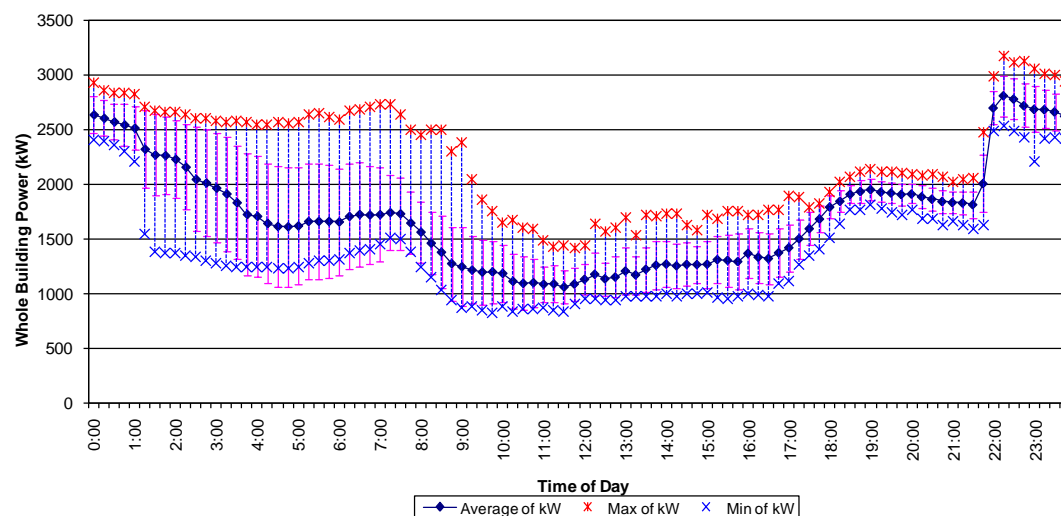
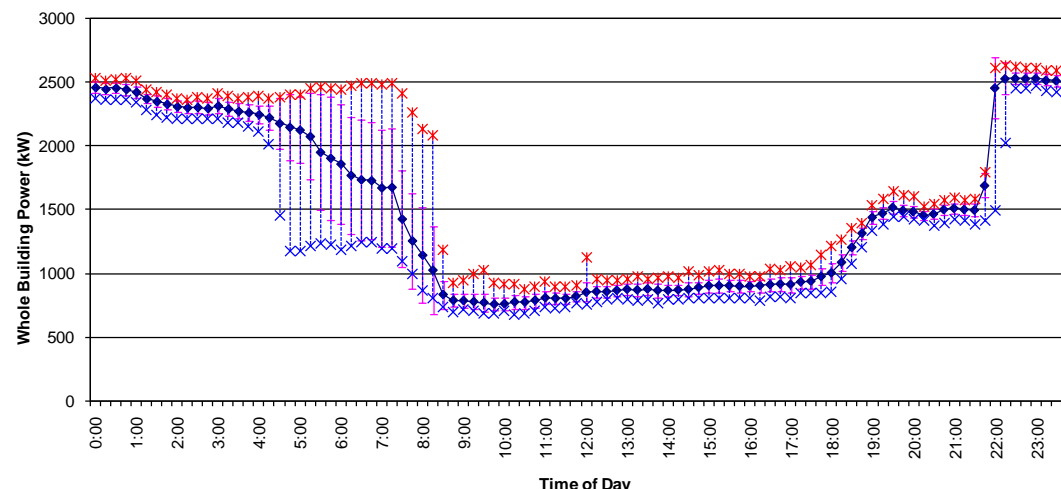




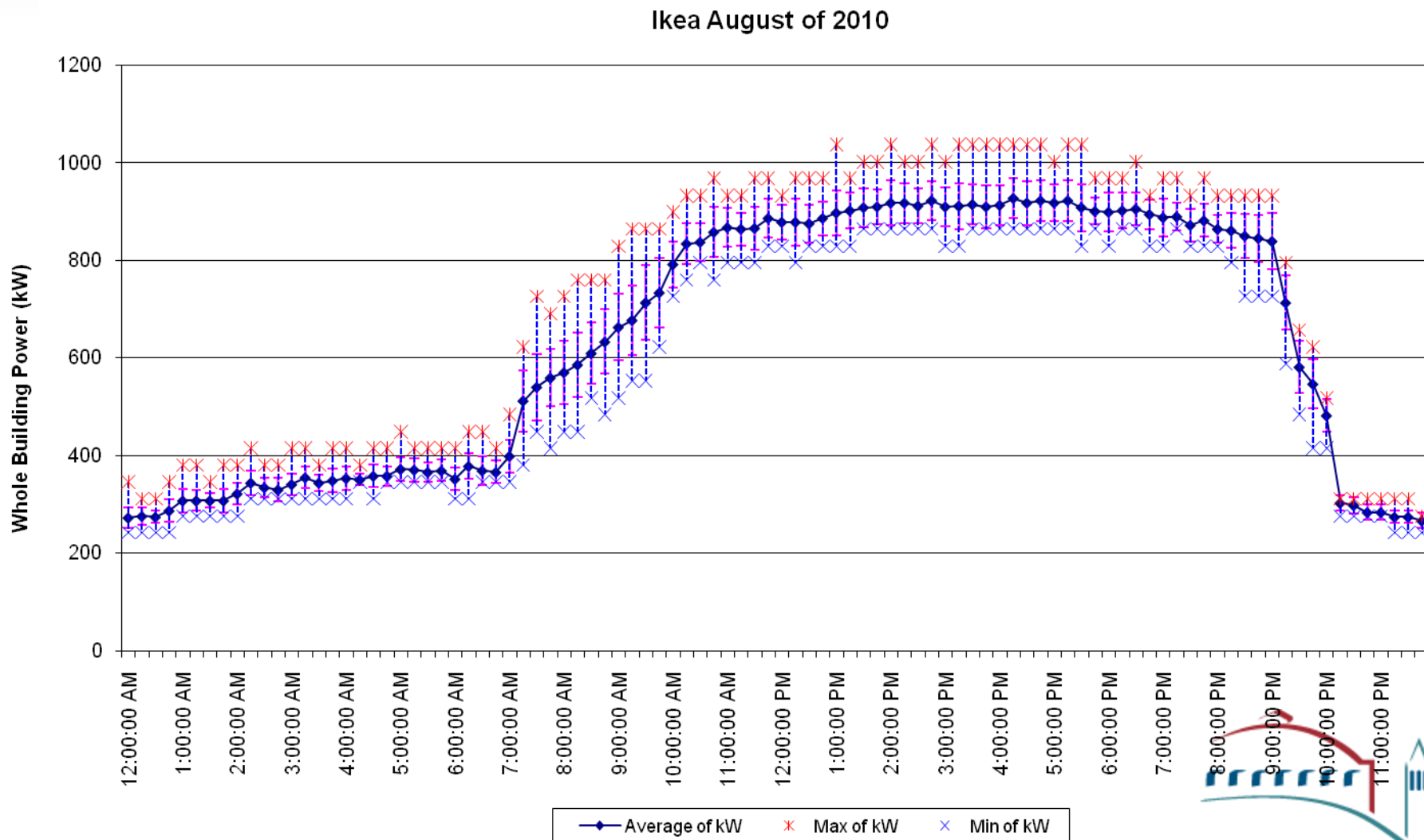
# Pre-Analysis of Sites – Load Statistical Summary (LSS)

LSS a plot of average, minimum and maximum points for a given range of dates.

- Refined to display Near-base load and near-high load (2.5 and 97.5 percentile values) (Price 2010)

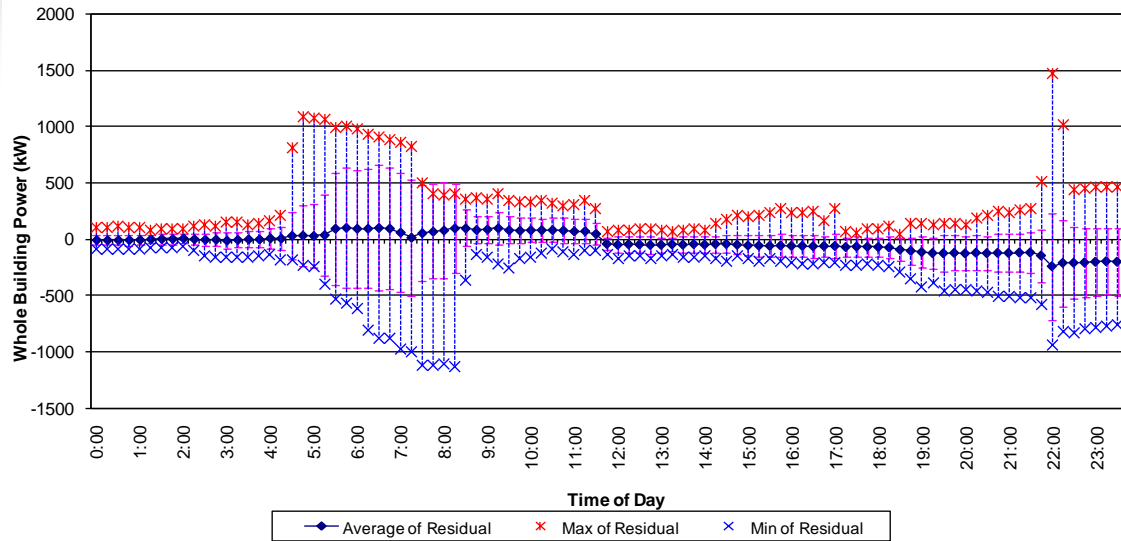


# Sample LSS

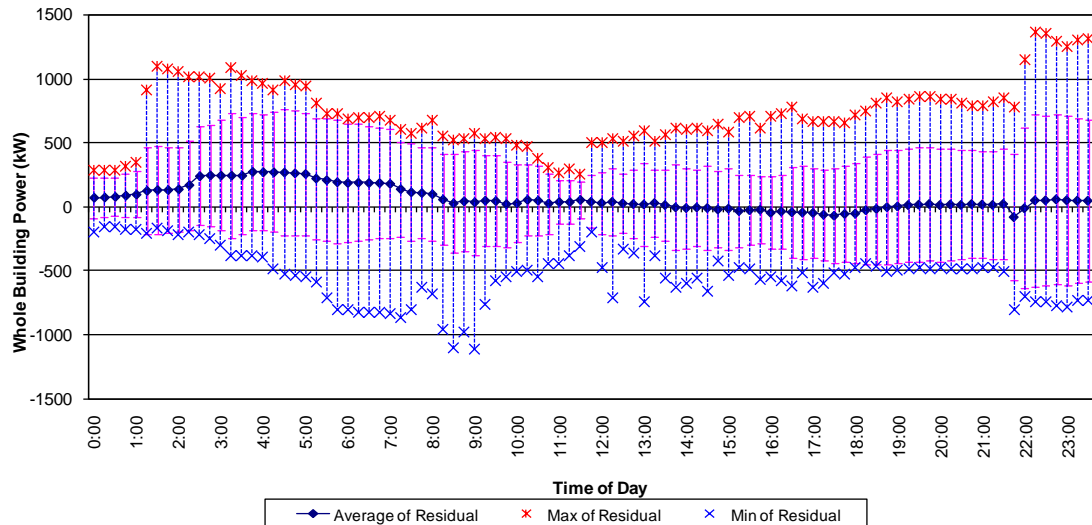


# Pseudo Generation Graphs with LSS

Residual University Of California Merced for July, 2010



Residual University Of California Merced for October, 2010



# End Uses & Response

End Use	Type	Ramp Down	Switching Off
HVAC	Chiller Systems	Setpoint Adj.	
	Package Unit	Setpoint Adj.	Disable Compressors
Lighting	Dimmable	Reduce Level	
	On/Off		Bi-Level Off
Refrig/Frozen Warehouse		Setpoint Adj.	
Data Centers		Setpoint Adj., Reduce CPU Processing	
Ag. Pumping			Turn Off selected pumps
Wastewater			Turn Off selected pumps



# Enablement Process

- Memorandum of Understanding (MOU) between Facility and Lawrence Berkeley National Laboratory
- Schedule meetings for enablement (controls vendors, LBNL, Akuacom and facilities)
  - Control Strategies
  - Communication Infrastructure
  - Telemetry Installation
- Communication and Control Test



# Pilot Timeline

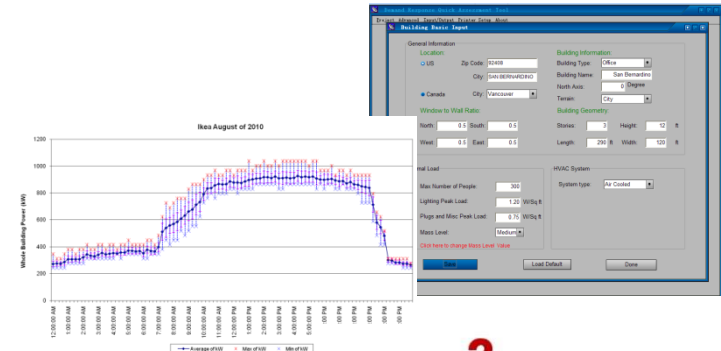
- February – Recruitment and Enablement
- March – Enablement
- April – Communication and Control Tests
- May through October – Field Tests
- November – Data analysis and report development
- December – Final Report



# Future Directions

## DR strategies as a “Modes” in Optimized Control

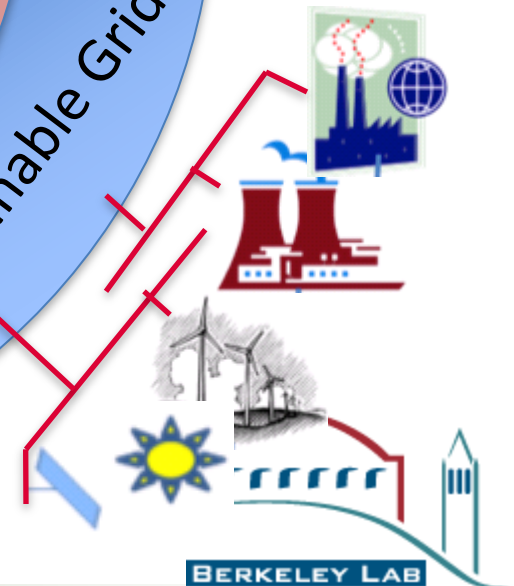
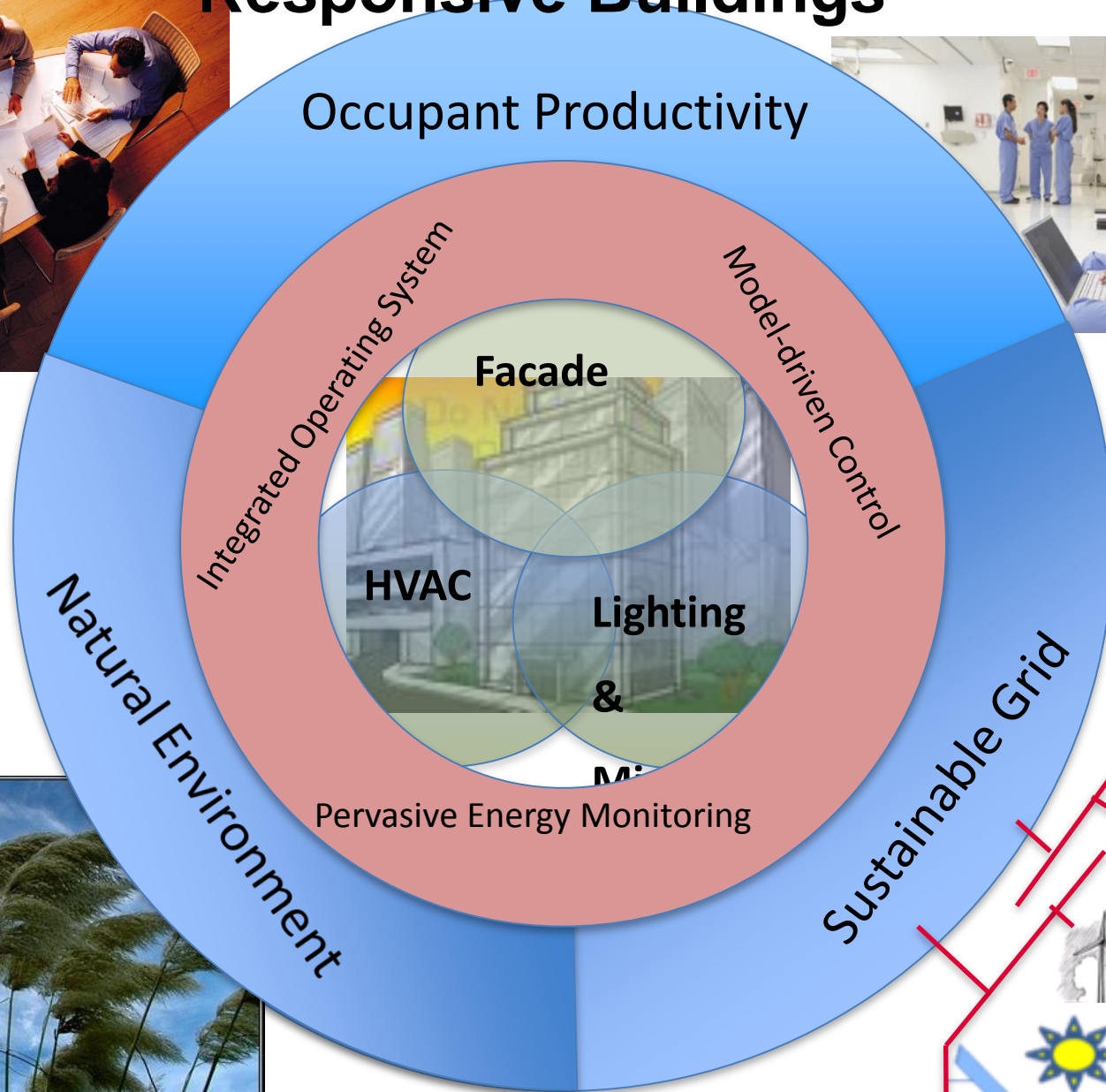
- Orchestrate modes using schedules, signals, optimization algorithms:
  - Occupied/Unoccupied
  - Maintenance/Cleaning
  - Warm up/Cool down
  - Night purge/Pre-cooling
  - DR modes
- Intelligence needed for decision making
- Financial feedback systems need to present operational value
- Embed DR communications client in EMCS – work toward codes, support BACnet and LON interoperability



See <http://drrc.lbl.gov/> for publications



# Responsive Buildings





# THANK YOU!

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